

(19) World Intellectual Property
Organization
International Bureau



17 MAR 2005

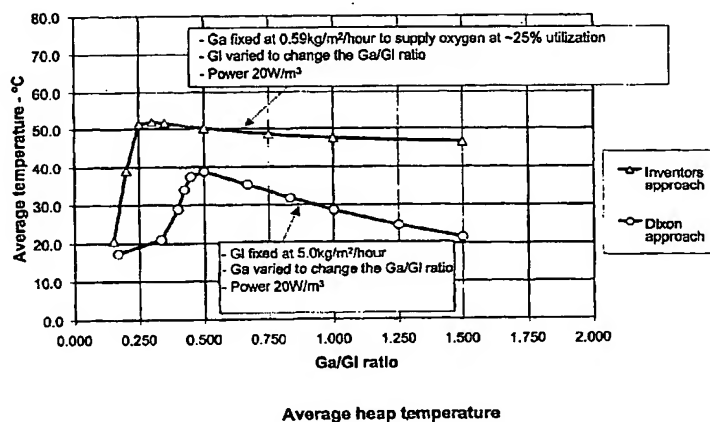
(43) International Publication Date
1 April 2004 (01.04.2004)

PCT

(10) International Publication Number
WO 2004/027099 A1

- (51) International Patent Classification⁷: C22B 3/00, 3/18, 15/00
- (21) International Application Number: PCT/TB2003/004103
- (22) International Filing Date: 15 September 2003 (15.09.2003)
- (25) Filing Language: English
- (26) Publication Language: English
- (30) Priority Data: 2002/7439 17 September 2002 (17.09.2002) ZA
- (71) Applicants and
(72) Inventors: CRUNDWELL, Frank, Kenneth [ZA/ZA];
10 Sussex Road, Parkwood, 2194 Gauteng Province (ZA).
NORTON, Alan, Eric [GB/ZA]; 22 Sering Street, Brack-
endowns, 1448 Gauteng Province (ZA).
- (74) Agent: BOWMAN GILFILLAN; (John & Kernick), P.O.
Box 3511, Halfway House, 1685 Midrand (ZA).
- (81) Designated States (*national*): AF, AG, AI, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.
- (84) Designated States (*regional*): ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SI, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PT, RO, SE, SI, SK, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).
- Published:
— with international search report
- For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: HEAP LEACH PROCESS



(57) Abstract: The invention discloses a method of controlling a heap leach process through controlling an irrigation rate of a heap as a function of at least one of an aeration rate of the heap, a determination of advection at least at one predetermined point in the heap, and a determination of temperature at least at one predetermined point in the heap. Also disclosed is for the aeration to be forced and for the method to include the step of controlling the aeration rate as a function of a determination of the oxidation rate of material within the heap. The invention also extends to a method for the introduction of microorganisms into the heap of material, a method for increasing the temperature of heap of material for heap leaching, a method of determining an optimum heap configuration for a bio-assisted heap leach process of an ore heap, and a method of enriching the environment of microorganisms embedded in a heap of material for bio-assisted heap leaching.

WO 2004/027099 A1

INTERNATIONAL SEARCH REPORT

 Internat Application No
 PCT/IB 03/04103

A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 C22B3/00 C22B3/18 C22B15/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 C22B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the International search (name of data base and, where practical, search terms used)

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 6 110 253 A (SHRADER VANDY ET AL) 29 August 2000 (2000-08-29) column 15, lines 29-53; column 11, lines 1-15 and 64-67	1-6, 10, 22-28, 46, 51-54
A	BRIERLEY C L: "Bacterial succession in bioheap leaching" HYDROMETALLURGY, ELSEVIER SCIENTIFIC PUBLISHING CY. AMSTERDAM, NL, vol. 59, no. 2-3, February 2001 (2001-02), pages 249-255, XP004227353 ISSN: 0304-386X section 2.2.	29
A	US 6 207 443 B1 (KING JAMES A) 27 March 2001 (2001-03-27) abstract; column 4, lines 17-24	29
-/--		

☒ Further documents are listed in the continuation of box C.☒ Patent family members are listed in annex.

* Special categories of cited documents:

- *A* document defining the general state of the art which is not considered to be of particular relevance
- *E* earlier document but published on or after the international filing date
- *L* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- *O* document referring to an oral disclosure, use, exhibition or other means
- *P* document published prior to the international filing date but later than the priority date claimed

- *T* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- *X* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
- *Y* document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
- *G* document member of the same patent family

Date of the actual completion of the international search

23 December 2003

Date of mailing of the international search report

12/01/2004

Name and mailing address of the ISA

 European Patent Office, P.B. 5818 Patentlaan 2
 NL - 2280 HV Rijswijk
 Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,
 Fax: (+31-70) 340-3016

Authorized officer

Bjoerk, P

INTERNATIONAL SEARCH REPORT

Interna Application No
PCT/IB 03/04103

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT		
Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	ZARATE G ET AL: "The metallurgy of the Mantoverde Project" HYDROMETALLURGY, ELSEVIER SCIENTIFIC PUBLISHING CY. AMSTERDAM, NL, vol. 39, no. 1, 1 October 1995 (1995-10-01), pages 307-319, XP004040739 ISSN: 0304-386X the whole document ----	33
A	MACLEOD F A ET AL: "PLUGGING OF A MODEL ROCK SYSTEM BY USING STARVED BACTERIA" APPLIED AND ENVIRONMENTAL MICROBIOLOGY, WASHINGTON, DC, US, vol. 54, no. 6, June 1988 (1988-06), pages 1365-1372, XP009011984 ISSN: 0099-2240 abstract ----	34
A	US 5 030 279 A (KRAUTH RICHARD G) 9 July 1991 (1991-07-09) claim 1 ----	1
A	DIXON D G: "Analysis of heat conservation during copper sulphide heap leaching" HYDROMETALLURGY, ELSEVIER SCIENTIFIC PUBLISHING CY. AMSTERDAM, NL, vol. 58, no. 1, November 2000 (2000-11), pages 27-41, XP004212100 ISSN: 0304-386X cited in the application -----	

INTERNATIONAL SEARCH REPORT

International application No.
PCT/IB 03/04103

Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☐ Claims Nos.:
because they relate to parts of the International Application that do not comply with the prescribed requirements to such an extent that no meaningful International Search can be carried out, specifically:
3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. ☐ As all required additional search fees were timely paid by the applicant, this International Search Report covers all searchable claims.
2. ☒ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this International Search Report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this International Search Report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest.
☐ No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/SA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. Claims: 1-32,34-55

Claims 1 to 32 and 34 to 55 are all linked to the controlling method of claim 1 where the irrigation rate of a heap is a function of at least one of an aeration rate, an advection measurement or a temperature measurement.

2. Claim : 33

Claim 33 relates to an optimisation of a heap configuration by measuring the leaching rate, the heat of reaction and the sulphide content of the ore and determining a maximum aeration rate, a maximum irrigation rate and an optimum heap height.

INTERNATIONAL SEARCH REPORT

International Application No
PCT/IB 03/04103

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
US 6110253	A	29-08-2000	AU 760930 B2	22-05-2003
			AU 1751300 A	03-07-2000
			CA 2352770 A1	22-06-2000
			US 2002194962 A1	26-12-2002
			WO 0036168 A1	22-06-2000
			ZA 200104405 A	02-07-2002
US 6207443	B1	27-03-2001	AU 760369 B2	15-05-2003
			AU 1852499 A	16-09-1999
			ZA 9901637 A	01-12-2000
US 5030279	A	09-07-1991	AU 600086 B2	02-08-1990
			AU 1149388 A	04-05-1989
			CA 1293521 C	24-12-1991
			US 5005806 A	09-04-1991